

Supplementary Materials: Role of Aquaporins in a Composite Model of Water Transport in the Leaf

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Table S1. Possible water-related, post-translational regulation of AQPs.

	Trigger	Research Approach/Findings	Suggested Mechanism	Reference
Membrane	Changes in cell turgor	Hydraulic conductivity of <i>Zea mays</i> parenchyma cells increased as light intensity increased. Yet, when transportation reduce cells turgor (more than 0.2 MPa reduction) L_p was reduced despite light.	AQP-gating (light and turgor).	[59]
	Membrane tension/changes in cell turgor	Membrane trafficking inhibitors inhibited the rate at which the volume of intact <i>Vicia faba</i> guard cells decreased following 0–1.5 MPa osmotic treatments.	None.	[101]
	Membrane tension	Pulses of turgor pressure on individual young <i>Zea mays</i> root cortex cells decreased the hydraulic conductivity (L_p) of those cells. Cells with high L_p responded to $HgCl_2$.	Inhibition was in proportion with the absolute value of water flow within the channel, possibly due to a mechanical stimulus.	[102]
	Membrane surface tension/changes in cell turgor	Osmotic permeability (P_f) and activation energy for water transport (E_a) of TIP2;1 grapevine (<i>Vitis vinifera</i>) were dependent on internal turgor pressure.	TIP2;1 acts as a gate in an internal pressure-dependent manner.	[120]
Stresses	Drought stress/drop in cytoplasmic pH (anoxia due to flooding)	X-rays of spinach (<i>Spinacia oleracea</i>) SoPIP2;1 in its closed and open conformation; molecular dynamic simulations.	Dephosphorylation of two conserved serine residues; protonation of a conserved histidine residue.	[106]
	Long-term drought	Dephosphorylation of PIP2s in tobacco (<i>Nicotiana tabacum</i>) leaves exposed to long-term drought; $HgCl_2$ decreased the water permeability of the leaf tissues of well-irrigated leaves.	AQP-gating (closed conformation) by dephosphorylation.	[109]
	ABA	Phosphoproteome analysis following ABA treatment revealed decreased phosphorylation of four members of the <i>Arabidopsis thaliana</i> PM AQP family.	AQP-gating (closed conformation) by ABA-dependent dephosphorylation.	[110]
	Apoplastic water potential/turgor	Osmotic stress changes AQP phosphorylation in spinach (<i>Spinacia oleracea</i>), in a manner dependent upon submicromolar concentrations of Ca^{2+} . AQP transcript levels are high in vascular tissue.	Phosphorylation by PM-associated protein kinase is strictly dependent on submicromolar concentrations of Ca^{2+} .	[107]
	Osmotic stress	Mannitol-induced water imbalance resulted in increased AQP in tonoplast fractions of ice plants (<i>Mesembryanthemum crystallinum</i>), as well as a shift in AQP distribution in other membrane fractions. Redistribution of McTIP1;2 was limited by trafficking inhibitors.	AQP re-localization suggests a role for glycosylation and the involvement of a cAMP-dependent signal in the redistribution of McTIP1;2.	[114]
	Osmotic gating	Inhibition of AQP activity in isolated <i>Chara corallina</i> internodes increased with as the concentration and molecular size of solutes increased (reflection coefficients).	Cohesion/tension model of AQP-gating.	[121,122]
	Salinity	Exposure of <i>Arabidopsis thaliana</i> roots to salt induces the redistribution of AQP to intracellular spherical structures tentatively identified as intravacuolar invaginations.	Subcellular re-localization of PIPs and TIPs.	[115]

Table S1. Cont.

	Trigger	Research Approach/Findings	Suggested Mechanism	Reference
Ion signals	Apoplast pH	HgCl ₂ prevented acidity induces swelling and floating of <i>Rhizopus delemars</i> spores.	pH-dependent AQP gating via histidine residues on the outer surface of the cell.	[111]
	Ca ²⁺ and H ⁺	Adding Ca ²⁺ caused a 4-fold reduction in the hydraulic conductivity of <i>Arabidopsis thaliana</i> cells in suspension. The ability of purified plasma-membrane vesicles to transport water was reversibly blocked by Ca ²⁺ and H ⁺ .	Ca ²⁺ and H ⁺ are involved in AQP-gating.	[113]
	Divalent cations and protons	Cd ²⁺ and Mn ²⁺ were also identified as potent inhibitors of <i>Pichia pastoris</i> AtPIP2;1S, showing dose-dependent effects on proteoliposomes containing AtPIP2;1.	Specific residues are involved in binding divalent cations and/or stabilizing open- or closed-pore conformations.	[112]
Temperature	Temperature change (5 °C to 20 °C)	Incorporation of ³² P into AQP in microsomal membranes of tulip (<i>Tulipa gesnerina</i>) petals was temperature- and time-dependent.	Phosphorylation of AQP by PM associated protein kinase is dependent on the concentration of Ca ²⁺ .	[108]
Unknown	?	Co-expression and physical interaction of nonfunctional and functional ZmPIPs resulted in changes in the permeability of <i>Xenopus</i> oocytes to water, based on the amount of injected complementary RNA.	Formation of alternative heterotetramers alters AQP activity.	[116]
	?	Artificial heterotetramers with a defined proportion of NtAQP1 to tPIP2;1 tetramer affected the transport of water in yeast.	Formation of alternative heterotetramers alters AQP activity.	[119]
	?	MpPIP1;1 (which exhibits no water-channel activity) facilitated the activity of MpPIP2;1 in a phosphorylation-dependent manner.	Cooperative regulation of MpPIP2;1 was regulated by phosphorylation of MpPIP1;1.	[117]